



# RESPONSIVE LIGHTING DESIGN PRINCIPLES

## Community Responsive Design

An exterior lighting design should be responsive to the community in which it is located. The design should take into consideration the feelings of the people who will experience it on a daily basis—the citizens of the community. Because of the great variety of individuals in the community, each with their own set of values and preferences, there is a large number of issues the designer must confront in order to satisfy the community and create a successful project.

### *Light Trespass*

Light trespass is “unwanted light that falls beyond the property line or area intended to be illuminated.” When introducing a new light source to an area, it is desired to limit the amount of light that spills over onto adjacent properties, in order to minimize disputes between neighbors. When doing the initial lighting design, the design professional must inspect the properties adjacent to the object or area that he or she is lighting. The goal is to determine where any potential conflict areas lie, and to eliminate those conflicts in the design stage, before they arise in the field.

The designer should also be careful in selection and location of the light fixtures. The fixtures should have



precise optical control in order to direct the light onto the surfaces where it is desired. When possible, a



**Figure 2.1** *Bad light trespass*

fixture should be selected that is well-shielded, or has the potential to be shielded should the need arise in the future. Aiming of the fixtures is also important; floodlight

aiming angles should be very precise to keep the light in the intended lighted area and out of areas it is not wanted.

### **Light Pollution**

Light pollution is “light that is directed upward to the sky or reflected from surfaces that interferes with astronomical observations or appreciation of the night sky.” Particles in the air, such as dust and water vapor, reflect and scatter light that is emitted into the atmosphere, resulting in this light pollution or “sky glow.” One of the best ways to control light pollution is to limit the amount of light leaving a fixture from the horizontal or above. The designer should also attempt to minimize the amount of non-target illumination; that is, when projecting light upwards, the system should be designed to apply the light only to the desired object, with as little light as possible spilling out into the atmosphere. The image in figure 2.2 was taken just a few miles from a prison in Arizona. Light pollution from the prison makes it look like



**Figure 2.2** *Example of light pollution*

Figure 2.3 is a satellite photo of the U.S. from space. All of the light reaching the satellite is wasted energy.



**Figure 2.3** *Night view from a satellite*

***Design principles should lead to an enhancement of visual signals and a reduction in visual noise.***

### **Appropriate Community Design**

The lighting of buildings’ facades can define the urban character and image of a community. For example, Las Vegas, Nevada and Williamsburg, Virginia are both popular tourist destinations. However, they both have significantly different images and characters, particularly at night. Illuminating the historic buildings in South Bethlehem will reveal the rich history of industry and cultural diversity. Consistency and coordination with specific techniques outlined in this plan will strengthen the public perception. By layering the light to create visual anchors and landmarks, visual orientation can be improved and a sense of community created. Following the historic community theme, lighting equipment for each building should be integrated so as to not detract from the daytime scenes.

### **Owner Responsive Design**

The lighting designer must not only consider the community in the design process, but also the owners of the individual building or structure. Each owner has a certain image of his or her business or organization that he or she wants to project. The lighting designer can help better portray this image by lighting the structure in an effective manner. In addition to projecting a certain image for an owner, the lighting professional must also consider maintenance on the lighting system, energy consumption, and cost.

### **Maintenance**

Properly maintained equipment results in a functional lighting system that suffers little from wasted power, misaligned light fixtures, and lamp burn-outs. When outdoor lighting equipment is operating as designed, it

suggests civic pride and a continuing concern about public safety and security. Good maintenance includes more than just keeping the light fixtures clean and relamped. There are important decisions to be made in the initial design.

These decisions affect maintenance, and include selecting the proper light fixture, lamp, and other system components; accommodating light fixture accessibility; and considering the level of system maintenance that will actually be implemented.

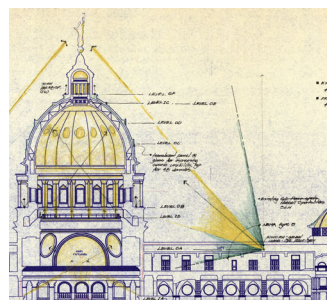
Several steps can be taken during installation to facilitate the future maintenance process. Ground-based equipment should be mounted where it is accessible for easy inspection and maintenance. All switching devices such as circuit breakers, contactors, and switches should be clearly labeled regarding the circuits and equipment they control. Except under rare circumstances, the light fixture power feeds should be run underground in conduit, avoiding the use of overhead wiring. All light fixture components and aiming devices should be securely fastened and tightened. Finally, all equipment should be thoroughly tested to make sure it is operating as specified.

### Energy

Besides maintenance, the lighting designer should also be sensitive to the amount of energy consumed by the lighting system. The selection of light fixtures, lamps, ballasts, and number of fixtures will all affect how much energy the system uses. Saving more energy not only puts more money in the pockets of the building owner, but is also an ecologically friendly solution, which further enhances the image of the owner. In figure 2.5, the blue shading represents the old 1000 watt floodlighting that lit the Pennsylvania State Capitol. The yellow



**Figure 2.4** *Poorly maintained floodlight*



**Figure 2.5** *Pennsylvania State Capitol*

represents the properly selected 100 watt floodlight that is now used to light the dome. The energy savings paid for the installation in a little over one year.

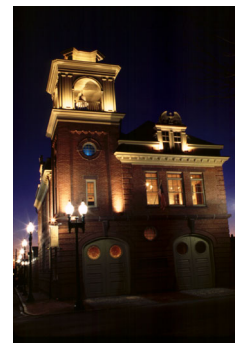
### Cost

**Materials**--The lighting designer should attempt to create a cost-effective design in ways other than just energy consumption. He or she must address the material cost of the lighting system, both on a first-cost basis and according to the life of the system. Equipment selection will determine the cost of replacing component parts, and the frequency with which that replacement will have to occur.

**Labor**--Besides material cost, labor cost must also be considered. The choice of light source and daily operating schedule will determine how often lamps must be replaced; light fixture mounting method and location will affect how often the fixtures must be cleaned; and the quality of equipment selected will determine component life expectancy, which dictates how often those components must be replaced.

## Design Principles

The general objectives that are outlined can be translated into a series of practical design principles that serve as guidelines for the development of the lighting master plan and the execution of future lighting designs. In formulating these principles, it is helpful to remember that the lighting system is a means to provide or transfer visual information, relevant to these basic objectives.



**Figure 2.6** *Greater Harrisburg Fire Museum*

### Illumination (quantity of light)

Good transfer of a visual signal is not necessarily based on the absolute quantity of light, but rather uniformity and contrast. A uniformity ratio compares the average light level across a surface to the minimum value on that surface. According to the Illuminating Engineering Society of North America, the recommended uniformity ratios for an even wash is a range of between 3:1 and 6:1, average to mini-





mum. It is only in the change or anomaly in a regular pattern that attracts attention. A change of 10:1 is considered noticeable, while 50:1 is obvious.

Care must be taken not to overwhelm nearby buildings or lighting installations. “Light Wars” occur when one building owner feels that in order to be noticed, he must light his building brighter than his neighbor’s building. Then a third building owner puts twice as much light on his building, and so on. It becomes a war that everyone loses, including visitors to the city. Through the Lighting Master Plan, a building hierarchy is established that best benefits the City as a whole.

### Limiting Glare

A common source of visual noise is glare caused by luminaires with improper beam control. Independent of illumination, glare levels make the task of seeing more difficult and produce a subtle sense of discomfort or annoyance. The lighting system should be designed to minimize glare.



**Figure 2.7** *Example of glare*

Glare can be broken down into two categories. First is discomfort glare. Discomfort glare causes the viewer to squint and can detract from the object being viewed. Disability glare is the second type, and a more severe condition. Disability glare can cause a total loss of vision such as looking at on-coming high beam headlights.

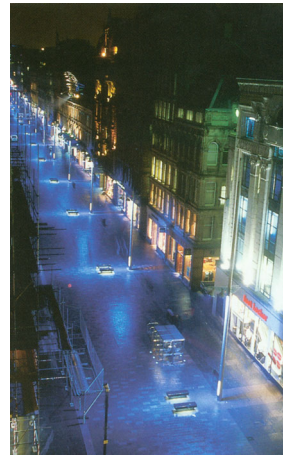
It may not be possible to completely hide every light fixture, but efforts should be made to avoid glare. Proper fixture selection and location can help limit this potential issue.



**Figure 2.8** *Color washing of facade*

### Use of Color

The use of color can be very dramatic and playful on a building facade. It can

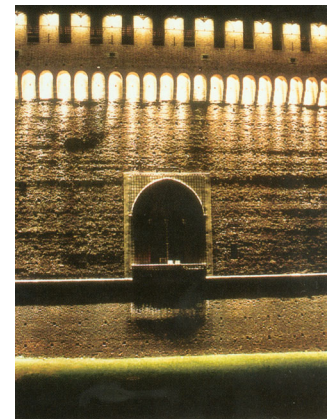


**Figure 2.9** *Example of color on streetscape*

be used to create a mood or tell a story. For example, the color projected on a building can be changed every evening to forecast the weather for the following day (yellow-sun; blue-rain; white-snow, etc.). Color has significant impacts that must be considered early in design. A large amount of green light bouncing off a building facade could give pedestrians a sickly appearance. Just as when color is applied to interiors, surrounding color schemes must be considered to maintain an aesthetically pleasing view of the city.

### Use of Texture

Texture can give life to a facade or create a meaningful statement. Grazing a stone or brick facade can show the material and structure of a building in a manner that has never been seen before. When viewed by flat ambient daylight, a stone wall has small bumps; at night that same wall can show large, random, beautiful patterns in the stone offset.



**Figure 2.10** *Grazing of wall*



**Figure 2.11** *Example of grazing*